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License Plate Recognition using Optical Character Recognizer and Artificial neural network

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ABSTRACT

License Number Plate Recognition (LNPR) became a very important tool in our daily life because of the unlimited increase of cars and transportation systems, which make it impossible to be fully managed and monitored by humans. Examples are so many, like traffic monitoring, tracking stolen cars, managing parking toll, red-light violation enforcement, border and customs checkpoints. Yet, it's a very challenging problem, due to the diversity of plate formats, different scales, rotations and non-uniform illumination conditions during image acquisition. The objective of this paper is to provide a novel algorithm for license plate recognition in complex scenes, particularly for the all-day traffic surveillance environment. This is achieved using morphology and artificial neural network (ANN) with Optical Character Recognizer (OCR). A preprocessing step is applied to improve the performance of license plate localization and character segmentation in case of severe imaging conditions. The first and second stages utilize and Threshold based segmentation followed by connected component analysis. ANN is employed in the last stage to construct a classifier to categorize the input numbers of the license plate. The average accuracy of the license plate localization is 99.76%. The experimental results show the outstanding detection performance of the proposed method comparing with traditional algorithms.

Keywords : Plate localization,, optical character recognizer, threshold based segmentation, preprocessing ,domain adaptation, image quality assessment, character recognition, Edge based techniques.

I. INTRODUCTION

Automatic number-plate recognition is a technology that uses optical character recognition on images to read vehicle registration plates. It can use existing closed-circuit television, road-rule enforcement cameras, or cameras specifically designed for the task. ANPR is used by police forces around the world for lawenforcement purposes, including to check if a vehicle is registered or licensed. It is also used for electronic toll collection on pay-per-use roads and as a method of cataloguing the movements of traffic for example by highways agencies.

Automatic number plate recognition can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. ANPR technology must take into account plate variations from place to place.

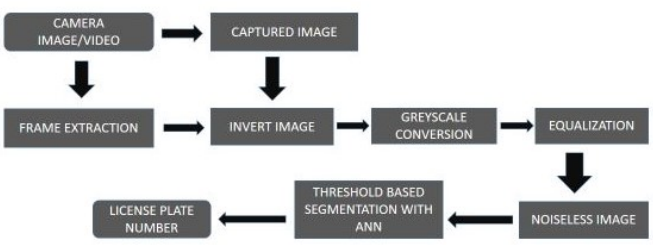
Concerns about these systems have centered on privacy fears of government tracking citizens' movements, misidentification, high error rates, and increased government spending. Critics have described it as a form of mass surveillance. Human intervention in ALPR systems can be reduced by boosting the

performance of each ALPR module individually and hence, improve the overall system performance.

We divide the task into five sub tasks: preprocessing, license plate localization, license plate extraction, optical character recognition. The image containing a license plate will be first processed by the license plate localization system, once the location of the license plate in the image is found, the optical character recognition system will extract the characters from the license plate.

The character will be recognized after the information is processed by the edge detection algorithm. Imperfect images create challenges for the optical character recognition system. The challenges faced are font, color, and background images on a plate. To the addition of a logo, symbols, dirt or noise material on the plate can cause the system to fail to detect and recognize the characters.

ARCHITECTURE



II. LITERATURE SURVEY

A. FAST LICENSE PLATE DETECTION BASED ON EDGE DENSITY AND INTEGRAL EDGE.

Description

A sliding-window and conditions with adaptive threshold values are used to detect multiple license plates with various sizes.The method for license plate detection consists of following steps: image preprocessing, coarse window detection, fine window detection, and candidate verification.To improve the efficiency of the algorithm the concept of integral image was adopted.

Advantage

Fast license plate detection presents a robust algorithm for license plate detection that can detect multiple license plates with various sizes in unfamiliar and complex backgrounds.

Issue

The most common restrictions in these methods include fixed distance or small known range between the camera and the vehicle, simple and familiar background, and existence of only one license plate within the image.

B. VARIANCE WINDOW BASED CAR LICENSE PLATE LOCALIZATION

Description

First, the image is decomposed using a Haar wavelet to get the HL band with vertical edges. Then,the HL band image is binarized using an Otsu threshold. Next a black top-hat algorithm is applied to reduce the effects of interfering large continuous features other than the license plate. At this time, a moving window based modified variance score calculation is made for areas with white pixels.

Advantage

The wavelet technique of using the Haar wavelet has many advantages, such as high speed, a smaller output image and image components that separate horizontal from vertical edges. The de-composition of the image using a Haar wavelet.The black top-hat method is used to reduce the impact of large, low-variation elements in the image in this work.

Issue

Although the plate has a lot of high frequency variation that would likely be preserved by a top-hat filter, many of the other features like the tail lights, car edges and others would likely be removed. This step helps to reduce the chance for false positives, but also reduces the amount of white pixels in the image.

C. ENTRY AND EXIT MONITORING USING LICENSE PLATE RECOGNITION

Description

Adaptive Histogram Equalization AHE, active contour method is used for region separation.Optical Character Recognition to recognize the characters.Deep Neural Network is used for classification and extracting the text as an alphanumeric characters and comparing the text with the predefined table created in MYSQL server and changing the status accordingly.

Advantage

Most tracks from a given entry location to a given exit will lie close.Associating entrance events, customer service events, and transaction log information.

Issue

In order to remove the edges that is horizontal and vertical edges which is apart from the boundary lines are removed because it may give some complexity to the algorithm

D. REAL-TIME BRAZILIAN LICENSE PLATE DETECTION AND RECOGNITION USING DEEP CONVOLUTIONAL NEURAL NETWORKS

Description

The Support vector machines (SVMs) is a robust and tunable algorithm that can be used for detection any kind of plate in the images. The algorithm needs two parameters; pattern and test image. Then instead of processing whole image region, the image is broken to list of preparatory zones and in order during frequent process, zones are selected.

Advantage

Support vector machines (SVMs) are very popular and powerful in pattern learning because of supporting high dimensional data and at the same time,providing good generalization properties.

Issue

The edge based algorithms are sensitive to unwanted edges such as noise edges, and they fail when they are applied to complex images.

E. CAR PLATE RECOGNITION BASED ON CNN USING EMBEDDED SYSTEM WITH GPU

Description

A built-in system was implemented with a GPU in order to recognize the license plate number without detection line. The deep-learning network to recognize the license plate number of the vehicle uses relatively simple AlexNet. AlexNet consists of

five convolution layers and three fully connected layers.

Advantage

For effective recognition, Jetson TX is used,which is suitable for embedded projects such as drone, autonomous robot systems, and mobile medical imaging, with high-performance low power computing capability suited to deep-learning and computer vision.

Issue

CPU is usually heavily loaded and in many cases that CPU alone cannot meet the real-time requirement at all.

III. PREPROCESSING

The use of preprocessing techniques may enhance a document image preparing it for the next stage in a character recognition system. Using effective preprocessing algorithms makes the OCR system more robust mainly through accurate image enhancement.The preprocessing techniques that are used:

- Invert image
- Greyscale conversion
- Equalization
- Noiseless image

Invert image is used to get the photographic negative of an colour image or to make the features in an image appear clearer.Inverting the image makes the objects appear in white on a dark background, which is often more suitable for character recognition of license number plate.

A grayscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information.Images of this sort, also known as black-and-white or monochrome, are composed exclusively of shades of gray , varying from black at the weakest intensity to white at the strongest.Applying to get the gray image from the invert the image.

Equalization is a method in image processing of contrast adjustment using the image's histogram.The spatial domain is represented by the conventional imageThe processes of adjusting contrast, sharpening; background removal, etc. are all forms of spatial convolution.

Noise is the result of errors in the image acquisition process that result in pixel values that donot reflect the true intensities of the real scene.We use Gaussian Filter to remove the noise from the image.

IV. LICE NSE PLATE LOCAL IZ AT ION

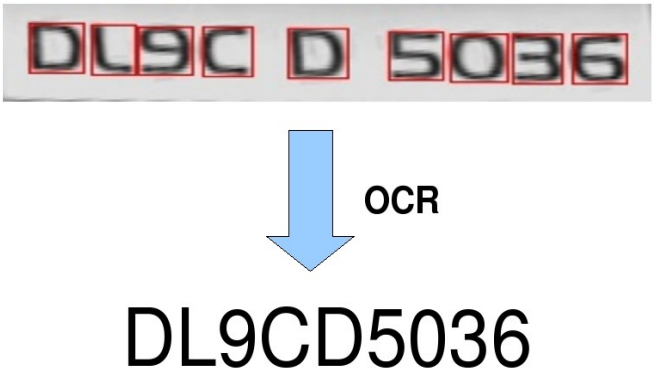
A License Plate (LP) is a rectangular metal plate contains numbers, characters and words, fixed on the car body and is used to identify the vehicles. The image processing algorithm is used for license plate localization. There are two stages in License plate Localization. They are identify the license plate and differentiate readable set and unreadable set. The readable set consists of number plates that can be recognized by humans whereas unreadable set consists of number pates that cannot be recognized by humans.

The first step is graphically rendering license plate characters onto blank license plate images. This rendering process considers effects such as font, spacing, layout, embossing, shadow, etc. to realistically mimic actual license plate images. The second step is mimicking imaging distortions typically encountered in the capture

process. These distortions include color-to-infrared conversion, image blur, brightness and contrast variations, plate noise, and geometric distortions. The distortion parameters can be derived by solving an optimization problem or by a direct analysis and measurement of a small number of real license plate images.

V. TRAINING SETS FOR OCR

Optical Character Recognition, or OCR, is a technology that enables you to convert different types of documents, such as scanned paper documents or images captured by a digital camera into editable and searchable data. The performance of OCR can be improved by applying unsupervised domain adaptation.



Domain Adaptation is a field associated with machine learning and transfer learning. This scenario arises when we aim at learning from a source data distribution a well performing model on a different (but related) target data distribution. Note that, when more than one source distribution is available the problem is referred to as multi-source domain adaptation. It uses set of samples from training set and the set of samples from actual camera images thus obtained. The localized license plate image is first vertically cropped and horizontally aligned using a low- level image processing techniques, similar to the operations used in conventional ALPR systems prior to segmentation. There are a number of possible difficulties that the software must be able to cope with. These include: Poor file resolution, usually because the plate is too far away but sometimes resulting from the use of a low-quality camera; Blurry images, particularly motion blur; Poor lighting and low contrast due to overexposure, reflection or shadows

VI. THRESHOLD BASED SEGMENTATION

The next steps in the OCR process after the line segmentation, word and character segmentation, isolate one word from another and separate the various letters of a word. In most cases, separating words is not that hard. There's always a distinct white space between them. The horizontal space between words in a line is called "interword space". Which leads us to the phenomenon of justification: typographists adjust the interword space and the interletter space to achieve justification.

License plate number recognition is achieved using morphology edge detection and artificial neural network (ANN). A pre-processing step is applied to improve the performance of license plate localization and character in case of severe imaging conditions. The first and second stages utilize Threshold Based Segmentation followed by ANN. ANN is employed in the last stage to construct a classifier to categorize the input numbers of the license plate. The algorithms has been applied on car images with different backgrounds, license plate angles, distances, lightening conditions, and colors.

Threshold Based Segmentation technique were also implemented to detect and segment the plate based on the high density of vertical and horizontal inside it In this phase, an input color image is exposed to a sequence of processes to extract the relevant 2-D objects that may represent the symbols constituting the LP.In LP detection, Closing operation (dilation followed by erosion) is performed to fill noisy holes inside candidate objects and to connect broken symbols

VII. VITERBI STYLE DYNAMIC PROGRAMMING ALGORITHM

Let $\delta(i, j)$ be the probability of a plate character sequence
of length i whose i *th* character is c_j. Let $\gamma(i, j)$ be the
probability of a plate character sequence of length i whose
i *th* character is c_j, defined by the lowest probability character
in the sequence

procedure GETPLATECODE
Initialize: $\delta(i, j) = 0$, $\gamma(i, j) = 0$, for $i, j = 1..N$
for j = 1 to N **do**
$\delta(1, j) = O(j)$
$\gamma(1, j) = O(j)$
end for
for i = 2 to N **do**
for j = 1 to N **do**
$k* = Argmax k$=1.. j–1$\delta(i - 1, k)A(k, j)O(j)$
$\delta(i, j) = \delta(i - 1, k*)A(k*, j)O(j)$
$\gamma(i, j) = Min(\gamma(i - 1, k*), A(k*, j)O(j))$
$back(i, j) = k*$
end for
end for
for i = 1 to N **do**
$j* = Argmax j$=1..$N\delta(i, j)$ - last character for athe most probable plate sequence of length i
$yMax(i) = \gamma(i, j*)$
$code(i)$ = backtrack($i, j*, back$) - backtrack from $j*$ to get most probable code sequence of length i
end for
$L = Argmaxiymax(i)PLM(code(i)$ - best plate length
$code*$ = $code(L)$ - best plate code
end procedure

VIII. CONCLUSION

In tollgate, the number of vehicles passed will be easily recorded. Since it convert images to text and then store it in database. It consumes less amount of space to store the data in database ,compared to previous ones.Because in existing model, they perform image into image conversion and store it to database. But, in this we convert images to text and only stored into database.Minimizing manual annotation and data collection required for training OCR classifiers in new jurisdictions/countries plays a key role in reducing the installation time for ALPR systems.

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